CLAIMS

We claim:

1. Semiconductor chip which emits electromagnetic radiation, having

- an epitaxially produced semiconductor layer stack (1) based on nitride semiconductor material, which includes an n-conducting semiconductor layer (11), a p-conducting semiconductor layer (13) and an electromagnetic radiation generating region (12) which is arranged between these two semiconductor layers (11, 13),
- a base (50), on which the semiconductor layer stack (1) is arranged, and
- a mirror layer (40), which is arranged between the semiconductor layer stack (1) and the base (50) and reflects electromagnetic radiation emitted by the semiconductor layer stack (1) in the direction of the base (50),

characterized in that

- the mirror layer (40) has a plurality of planar reflection sub-surfaces (14), which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 10° and 50° with this plane.

2. Semiconductor chip according to Claim 1, characterized in that the p-conducting semiconductor layer (13) faces the base, and the mirror layer (40) is formed by means of a reflection surface (131) of the p-conducting semiconductor layer (13), which includes a plurality of planar sub-surfaces (14) which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 10° and 50° with this plane.

3. Semiconductor chip which emits electromagnetic radiation, having

- an epitaxially produced semiconductor layer stack (1) based on nitride semiconductor material, which includes an n-conducting semiconductor layer (11), a p-conducting semiconductor layer (13) and an electromagnetic radiation generating region (12) which is arranged between these two semiconductor layers (11, 13),
- a base (50), on which the semiconductor layer stack (1) is arranged, and
- a mirror layer (40), which is arranged between the semiconductor layer stack (1) and the base (50)

characterized in that

- the n-conducting semiconductor layer (11) faces away from the base, and
- the n-conducting semiconductor layer (11) or an outcoupling layer (16) located on the n-conducting semiconductor layer (11) has a radiation-outcoupling surface (111) which in turn includes a plurality of planar outcoupling sub-surfaces (14) which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 15° and 70° with this plane.

4. Semiconductor chip which emits electromagnetic radiation according to Claim 2, in which an outcoupling layer (16) is arranged at least partly on the n-conducting semiconductor layer (11).

5. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the n-conducting semiconductor layer (11) or an outcoupling layer (16) located on the n-

conducting semiconductor layer (11) has a radiation-outcoupling surface (111) which in turn includes a plurality of planar outcoupling sub-surfaces (14) which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 15° and 70° with this plane.

6. Semiconductor chip which emits electromagnetic radiation according to Claim 5, in which the reflection sub-surfaces (14) or the outcoupling sub-surfaces (14) form pyramid-like structures (15).

7. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the mirror layer (40) includes a plurality of different layers.

8. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the mirror layer (40) comprises

- a highly reflective layer (41), and/or
- a protective layer (42), and/or
- a joining layer (43).

9. Semiconductor chip which emits electromagnetic radiation according to Claim 8, in which the highly reflective layer (41) contains silver or aluminium.

10. Semiconductor chip which emits electromagnetic radiation according to Claim 8, in which the protective layer (42) contains titanium nitride.

11. Semiconductor chip which emits electromagnetic radiation according to Claim 8, in which the joining layer (43) contains gold, tin and/or an alloy of these metals.

12. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which an outcoupling layer (16) located on the n-conducting semiconductor layer (11) contains SiC or consists of SiC.

13. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the semiconductor layer stack (1) includes at least one trench (17) which defines a plurality of individual semiconductor layer elements (18).

14. Semiconductor chip which emits electromagnetic radiation according to Claim 11, in which a plurality of trenches (17) are provided, extending in such a manner that the semiconductor layer elements (18), in plan view, are in the shape of a circle, a hexagon, a quadrilateral, a triangle or a combination of these shapes.

15. Semiconductor chip which emits electromagnetic radiation according to Claim 14, in which the semiconductor layer elements (18) each have a diameter or a width which includes at most ten pyramid-like structures (15).

16. Semiconductor chip which emits electromagnetic radiation according to Claim 14, in which the trench(es) (17) are at least sufficiently deep for them to isolate at least the radiation-generating region (12).

17. Semiconductor chip which emits electromagnetic radiation according to Claim 14, in which the width of the trench (17) or trenches (17) is at least double the depth of the trenches.

18. Semiconductor chip which emits electromagnetic radiation according to Claim 14, in which the trench(es) (17) are filled with an electrically insulating material (19) which transmits radiation generated by the radiation-generating region (12).

19. Semiconductor chip which emits electromagnetic radiation according to claim 1, in which a radiation-transmitting electrically conductive contact layer (2) is arranged on the n-conducting semiconductor layer (11).

20. Semiconductor chip which emits electromagnetic radiation according to Claim 19, in which the contact layer (2) contains indium tin oxide and/or ZnO.

21. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the semiconductor chip is a thin-film component, from which a growth substrate wafer

(10) is at least partially removed after the epitaxially produced semiconductor layer stack (1) has been grown.

22. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the p-conducting semiconductor layer (13) is doped with magnesium.

23. Semiconductor chip which emits electromagnetic radiation according to Claim 1, in which the base (50) contains gallium arsenide or copper.

24. Method for fabricating a plurality of semiconductor chips which emit electromagnetic radiation, comprising the following method steps:

a) provision of a growth substrate wafer (10),

(b) epitaxial growth of a semiconductor layer sequence on the growth substrate wafer (10), which includes a p-conducting semiconductor layer (13), an n-conducting semiconductor layer (11) and an electromagnetic radiation generating region (12) which is arranged between these two semiconductor layers (11, 13), the n-conducting semiconductor layer (11) being first of all grown on the growth substrate wafer (10), and a plurality of planar sub-surfaces (14), which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 10° and 50° with this plane, being formed on the p-conducting semiconductor layer surface,

(c) application of a mirror layer (40) to the p-conducting semiconductor layer (13),

(d) production or application of a base (50) on or to the mirror layer (40),

(e) removal of at least part of the growth substrate wafer (10) from the semiconductor layer stack (1),

(f) application of a contact layer (2) to the n-conducting semiconductor layer (11),

(g) separation of the wafer produced in steps (a) to (f) into individual semiconductor chips.

25. Method for fabricating a plurality of semiconductor chips which emit electromagnetic radiation, comprising the following method steps:

(a) provision of a growth substrate wafer (10),

(b) epitaxial growth of a semiconductor layer sequence (1) on the growth substrate wafer (10), which includes a p-conducting semiconductor layer (13), an n-conducting semiconductor layer (11) and an electromagnetic radiation generating region (12) which is arranged between these two semiconductor layers (11, 13), the n-conducting semiconductor layer (11) being first of all grown on the growth substrate wafer (10),

(c) application of a mirror layer (40) to the surface of the p-conducting semiconductor layer (13),

(d) production or application of a base (50) on or to the mirror layer (40),

(e) removal of at least part of the growth substrate wafer (10) from the semiconductor layer stack (1),

(ea) etching or mechanical patterning of the exposed n-conducting semiconductor layer (11) or of the remaining part of the growth substrate wafer (10), so that a plurality of planar sub-surfaces (14), which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 15° and 70° with this plane, are

formed on the n-conducting semiconductor layer surface or on the growth substrate wafer surface,

(f) application of a contact layer (2) to the n-conducting semiconductor layer (11),

(g) separation of the wafer produced in step a to f into individual semiconductor chips.

26. Method according to Claim 24, in which after method step (e) the remaining part of the growth substrate wafer (10) is at least partially patterned for the purpose of electrically contacting the n-conducting semiconductor layer (11).

27. Method according to Claim 26, in which before method step (f) the n-conducting semiconductor layer (11) or the remaining part of the growth substrate wafer (10) is patterned by means of an etching process or mechanical patterning in such a way that a plurality of planar sub-surfaces (14), which are positioned obliquely with respect to a main plane of the radiation-generating region (12) and each form an angle of between 15° and 70° with this plane, are formed on the n-conducting semiconductor layer surface or on the growth substrate wafer surface.

28. Method according to Claim 24, in which the reflection sub-surfaces (14) and/or the outcoupling sub-surfaces (14) form pyramid-like structures (15).

29. Method according to Claim 24, in which the mirror layer (40) is produced with a plurality of layers.

30. Method according to Claim 24, in which the mirror layer (40) is produced as a result of

- a highly reflective layer (41) being applied to the p-conducting semiconductor layer (13),
- a protective layer (42) being applied to the highly reflective layer (41) or, if the latter is not present, to the p-conducting semiconductor layer (13) and/or
- a joining layer (43) being applied to the protective layer (42) or, if the latter is not present, to the highly reflective layer (41) or, if the latter is not present, to the p-conducting semiconductor layer (13).

31. Method according to Claim 30, in which the highly reflective layer (41), the protective layer (42) and/or the joining layer (43) is/are applied by vapour deposition or sputtering.

32. Method according to Claim 24, in which, according to method step (d), the base (50) is soldered or adhesively bonded to the mirror layer (40).

33. Method according to Claim 24, in which, before method step (f), at least one trench (17) is patterned in the semiconductor layer stack (1), extending at least through the n-conducting semiconductor layer (11) and the electromagnetic radiation generating region (12) and thereby defining a plurality of individual semiconductor layer elements (18).

34. Method according to Claim 33, in which the trench(es) (17) are filled with an electrically insulating material (19) which transmits radiation generated by the radiation-generating region.

35. Method according to Claim 33, in which the trench(es) (17) are patterned by means of photolithography and/or etching.